Complete Summary

GUIDELINE TITLE

NKF-K/DOQI clinical practice guidelines for vascular access: update 2000.

BIBLIOGRAPHIC SOURCE(S)

NKF-K/DOQI clinical practice guidelines for vascular access: update 2000. Am J Kidney Dis 2001 Jan;37(1 Suppl 1):S137-81. [209 references]

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

End-stage renal disease (ESRD)

GUIDELINE CATEGORY

Evaluation
Management
Treatment

CLINICAL SPECIALTY

Family Practice
Internal Medicine
Nephrology
Pediatrics

INTENDED USERS

Advanced Practice Nurses
Allied Health Personnel

Clinical Laboratory Personnel
Health Care Providers
Health Plans
Nurses
Patients
Physician Assistants
Physicians

GUIDELINE OBJECTIVE(S)

1. The primary objective of the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative is to improve patient outcomes and survival by providing recommendations for optimal clinical practices, thereby increasing the efficiency of patient care, and positively impacting patient outcomes.
2. To provide evidence-based guidelines on vascular access for end-stage renal disease hemodialysis patients.

TARGET POPULATION

Adult and pediatric patients with end-stage renal disease who receive hemodialysis treatment.

INTERVENTIONS AND PRACTICES CONSIDERED

Patient Evaluation Prior to Access Placement

- Patient history and physical examination prior to permanent access selection
- Diagnostic evaluation prior to permanent access selection
- Selection of permanent vascular access and order of preference for placement of arteriovenous fistulae
- Type and location of dialysis arteriovenous graft placement
- Type and location of tunneled cuffed catheter placement
- Acute hemodialysis vascular access: noncuffed catheters
- Preservation of veins for arteriovenous access
- Timing of access placement
- Access maturation

Monitoring and Maintenance

- Monitoring dialysis arteriovenous grafts for stenosis
- Monitoring primary arteriovenous fistulae for stenosis
- Recirculation methodology, limits, evaluation, and follow-up

Prevention of Complications: Infection

- Infection control measures
- Skin preparation technique for permanent arteriovenous accesses
- Catheter care and accessing the patient's circulation

Management of Complications: When to Intervene

- Managing potential ischemia in a limb bearing an arteriovenous access
- When to intervene: dialysis arteriovenous grafts for venous stenosis, infection, graft degeneration, and pseudoaneurysm formation
- When to intervene: primary arteriovenous fistulae

Management of Complications: Optimal Approaches for Treating Complications

- Treatment of stenosis without thrombosis in dialysis arteriovenous grafts and primary arteriovenous fistulae
- Treatment of central vein stenosis
- Treatment of thrombosis and associated stenosis in dialysis arteriovenous grafts
- Treatment of thrombosis in primary arteriovenous fistulae
- Treatment of tunneled cuffed catheter dysfunction
- Treatment of infection of dialysis arteriovenous grafts
- Treatment of infection of primary arteriovenous fistulae
- Treatment of infection of tunneled cuffed catheters
- Treatment of pseudoaneurysm of dialysis arteriovenous grafts
- Aneurysm of primary arteriovenous fistulae

MAJOR OUTCOMES CONSIDERED

- Vascular access-related morbidity
- Long-term vascular access function
- Costs associated with the maintenance of access patency

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Hand-searches of Published Literature (Primary Sources)
Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

From the 1997 Guideline

Initial literature searches

With the help of a former senior subject heading specialist from the National Library of Medicine, project staff performed initial searches of four computerized bibliographic databases: The National Library of Medicine's MEDLINE(R), EMBASE, SciSearch(R), and BIOSIS(R) Previews. Staff used free text terms and controlled vocabulary, such as the NLM's Medical Subject Heading (MeSH). Searches were both general in scope for high sensitivity in identification of pertinent literature (for example, a search related to vascular access and end stage renal disease) and specific to preliminary topics selected by the Work Group Chairs for precision (for example, prevention of particular types of complications). In total 5,746 articles were identified by the initial searches.

Work Group Chairs identified the most important papers related to their topic. These papers were retrieved.

Records retrieved from the searches were transferred into topic-specific databases using Reference Manager, a commercial bibliography management software package. Staff used Reference Manager to maintain and track records throughout the process.

Mock guidelines, rationales, and question lists

To enhance both the sensitivity and specificity of the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative literature review, a systematic process was employed at the July 1995 Work Group meeting to define the questions to be addressed in the literature review. The process involved three sequential tasks. First, each Work Group developed a set of "mock guideline" statements that reflected the types of recommendations they would ultimately like to develop. For example, a mock guideline related to peritoneal dialysis adequacy was:

The dose of peritoneal dialysis that is actually delivered should be measured using (method).

Next, each Work Group developed a draft chain of logic or rationale, which delineated the logical sequence of issues and assumptions that would need to be addressed in order to come to a recommendation on each guideline topic.

For example, the draft rationale related to the preceding mock guideline was:

1. _____ and _____ are currently used to measure peritoneal dialysis dose.
2. _____ is more strongly associated with patient morbidity and mortality than is _____.
3. In addition, _____ is a more reproducible measure than _____.
4. In light of these considerations, _____ is the preferred approach for measuring peritoneal dialysis dose.

Finally, each Work Group worked with staff to develop a question list to be addressed in the literature review. The answers to these questions would fill in each link in the chain of logic, which could then be used to develop the practice recommendations. Specific questions for the example above were:

1. What is the association between total weekly urea clearance x time normalized by total body water, the volume of distribution of urea (Kt/V_{urea}) and patient mortality?
2. What is the association between weekly creatinine clearance and patient mortality?
3. Does knowledge of weekly creatinine clearance provide any additional information regarding expected patient survival than does knowledge of weekly Kt/V_{urea}?

Detailed literature abstraction forms were then developed to help Work Group members extract the answers to the questions from the literature review. To the Committee's knowledge, this is the first time such an approach has been

employed to focus a guideline development literature review effort. In previous guideline development efforts, expert panels have typically developed a list of questions to be addressed in the literature review without explicitly articulating the types of guideline statements they would ultimately like to issue. The result has often been that, after completing the literature review, a guideline development panel has found that it failed to address in the literature review several pertinent issues that needed to be considered to develop particular practice guidelines. By devoting considerable thought at the outset to "mock guideline" statements and the associated chain of logic that would underlie each, we were able to conduct a comprehensive, yet efficient literature review.

Complete supplemental and update searches

After determining that many pertinent papers were not identified during initial computerized searches, the Chair of each Work Group worked with staff to design supplemental computerized searches. These supplemental searches targeted the authors of important papers that had been missed and additional key words. All searches were updated through approximately September 1995. Additional pertinent articles identified by Work Group members and peer reviewers were added through June 1997.Screening the Literature

Work Group members performed the literature review. This entailed screening the literature for pertinence and then conducting a structured review.

The initial computerized searches of the literature identified 5,746 articles. Supplemental and update searches identified 5,065 more articles, and additions by Work Group members and staff yielded an additional 818 articles for a total of 11,629. To ensure that the detailed literature review process was efficient, a two-step screening process was employed to identify articles that would undergo a structured review.

In the first screen, each Work Group Chair reviewed a list of titles and abstracts obtained from the search of computerized literature databases. The Work Group Chairs were asked to eliminate articles that were clearly not relevant to the questions to be addressed in their Work Group's literature review. Work Group Chairs were instructed not to eliminate articles for any other reason, such as a belief that the journal in which the article was published was not highly regarded. Staff retrieved the full text of articles that passed the first screen.

The full text of articles that passed this first screen were then divided among Work Group members by the Work Group Chair. Work Group members were asked to read these articles and determine whether each was pertinent to the questions being addressed in the literature review or the guideline topic in general. Work Group Chairs typically assigned articles to individual Work Group members based on their expertise. During this pertinence review, two Work Group members reviewed each article and categorized articles as "key," "pertinent, but not key," or "not pertinent." Key articles were articles thought to be particularly important to the development of a particular guideline. Articles identified as either "key" or "pertinent, but not key" by at least one of the two Work Group members were then moved on to the next stage of the process, the structured review.

From the 2000 Update

The Vascular Access Work Group reviewed all scientific literature published in English from the initial publication of the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative guidelines in 1997 through 1999.

NUMBER OF SOURCE DOCUMENTS

Summary of Literature Review for Vascular Access from the 1997 Guideline:

Total articles identified (searches, later additions) = 3,577

First screen: articles retrieved in full text = 941

Second screen: articles that underwent structured review = 221

Total articles cited in final reports = 207

Summary of Literature Review for Vascular Access from the 2000 Update:

The update process for the four original Kidney Disease Outcomes Quality Initiative guidelines focused on a total of 85 articles published since 1996 and considered to be potentially relevant by the Work Group. Of these, 57 were subjected to structured review according to published Disease Outcomes Quality Initiative methods. The number of source documents for each clinical practice guideline was not delineated.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

In addition to the structured review of the clinical content of pertinent articles that was performed as part of the Disease Outcomes Quality Initiative Guideline development process, a structured assessment of the methodologic rigor of pertinent articles was performed. In this assessment, four tasks were performed. First, the type of study design used in the study was defined and used to assign the article to a United States Preventive Services Task Force Quality of Evidence Category (see Table 3 in the companion document to the original guideline titled "Methods Used to Evaluate the Quality of Evidence Underlying the National Kidney Foundation-Dialysis Outcomes Quality Initiative Clinical Practice Guidelines: Description, Findings and Implications"[*]). Second, for each article that underwent a methods review, up to 24 aspects of study design (the exact number depended on the type of study being reviewed) were rated as being fully, partially, or not fulfilled (see Table 4 in the companion document to the original guideline titled "Methods Used to Evaluate the Quality of Evidence Underlying the National Kidney Foundation-Dialysis Outcomes Quality Initiative Clinical Practice Guidelines: Description, Findings and Implications"[*]). The sum of the scores for those aspects of study design that applied to a given article was then divided by the number of applicable questions, yielding a methods score for the article between 0 and 1.

Third, the overall quality of each article that underwent a methods review was rated as excellent, very good, good, fair, or poor based on a global subjective judgment made by the methods reviewer. Finally, based on the results of these ratings, each article was assigned a grade of "a", "b", or "c". An "a" grade was assigned if at least 50% of the answers to the methods review questions that applied to the article (see Table 4 in the companion document to the original guideline titled "Methods Used to Evaluate the Quality of Evidence Underlying the National Kidney Foundation-Dialysis Outcomes Quality Initiative Clinical Practice Guidelines: Description, Findings and Implications"[*]) were answered "yes". A grade of "b" was assigned when less than 50% of the answers to methods review questions that applied to the article were answered "yes". A "c" grade was assigned to an article when at least one of the following four criteria applied to the article: (1) important demographic and/or prognostic characteristics of the enrolled sample were not described, (2) outcome measurements were not made in a similar fashion in the patient groups being compared, (3) the article received a global subjective quality rating of poor, or (4) the article was a case report. All methods reviews were performed by experienced individuals with masters or doctoral degrees in public health, epidemiology, biostatistics, or a similar discipline.

[*] See the companion document to the original guideline: Steinberg EP, Eknoyan G, Levin NW, et al. "Methods Used to Evaluate the Quality of Evidence Underlying the National Kidney Foundations-Dialysis Outcomes Quality Initiative Clinical Practice Guidelines: Description, Findings, and Implications." Am J Kidney Dis 2000 Jul;36(1):1-11. Available from the American Journal of Kidney Diseases Web site.

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Data Abstraction

Three types of data abstraction forms were used in the review process: (1) a content abstraction form designed for use in abstracting clinical data pertaining to each literature review question; (2) a methods assessment form designed to provide a rough assessment of the methodologic rigor of a paper; and (3) a detailed methods review form designed to assess the methodologic rigor of pivotal or controversial papers.

Staff used the detailed list of questions produced by the Work Groups to develop clinical content abstraction forms for each Work Group. Each detailed question posed by the Work Group was decomposed into subquestions that would capture pertinent data from studies that could vary tremendously in design, content, and presentation of data. Reviewers were asked to summarize any pertinent data from each article that were not addressed by the form and to provide comments on the overall quality of the paper. Renal fellows then pilot-tested the forms using articles identified in the search. Staff conducted conference calls with each topic-specific group of fellows following the pilot-test and reviewed issues and problems

with the draft forms. In addition, feedback from Work Group Chairs was incorporated into the draft forms before finalizing them.

Structured review

Articles identified as "key" or "pertinent, but not key," underwent structured review for both clinical content and methodologic rigor. Work Group members reviewed all "key" articles. This ensured that clinical experts reviewed the most important papers, and helped inform Work Group members of the content and quality of the papers. "Pertinent, but not key" articles were reviewed by renal fellows assigned to each Work Group.

Pertinent papers with primary or secondary data also underwent a methods review which was performed by staff with training in biostatistics and/or epidemiology. In the end, 1,447 articles, or 13 percent of those identified initially, were subjected to structured review.

Synthesis

The results of the literature review were compiled and synthesized when responses lent themselves to synthesis. Responses to qualitative questions were reported verbatim in tabular format. Quantitative data were presented in tabular format, and aggregated when possible. Since most studies did not report comparable data, aggregation was possible in only a limited number of cases.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Work Groups discussed the available evidence during two meetings and formulated draft guidelines and a rationale for each. In the rationale, the evidentiary basis (specific empirical data or expert opinion) for each recommendation was made explicit. Consensus was not forced. Rather, if divergent opinions emerged, the different viewpoints, and the basis for the divergent opinions, were recorded.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

When all components of the rationale for a guideline are based on published evidence, the guideline has been labeled "Evidence."

When some or all components of a rationale are based on opinion, the guideline has been labeled "Opinion."

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review
Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

As was the case with the initial guidelines, the current guideline updates were subjected to a three stage review process.

Stage One

They were presented first to the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative Steering Committee and revised in response to the comments received.

Stage Two

In the second stage, the Kidney Disease Outcomes Quality Initiative Advisory Board, along with other experts in the field, provided comments. After considering these, the Work Group produced a third draft of the guidelines.

Third Stage

In the final stage, this draft was made available for public review and comment by all interested parties, including end stage renal disease networks, professional and patient associations, dialysis providers, government agencies, product manufacturers, managed care groups, and individuals. The comments received were reviewed and, where appropriate, incorporated in the final version of the updated guidelines.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Evidentiary Basis for Recommendations:

When all components of the rationale for a guideline are based on published evidence, the guideline has been labeled "Evidence."

When some or all components of a rationale are based on opinion, the guideline has been labeled "Opinion."

1. Patient History and Physical Examination Prior to Permanent Access Selection:

   To determine the type of access most suitable for an end-stage renal disease patient, a history must be taken and physical examination of the patient's venous, arterial, and cardiopulmonary systems must be performed. Diagnostic evaluation should be performed when indicated based on patient history or physical examination. (Evidence/Opinion) Table III-1, below, outlines relevant aspects of patient history and physical examination and provides the rationale for evaluating them.

Table III-1: Patient Evaluation Prior Access Placement

Consideration	Relevance
Patient History	
History of previous central venous catheter	Previous placement of a central venous catheter is associated with central venous stenosis.
Dominant arm	To minimize negative impact on quality of life, use of the non-dominant arm is preferred.
History of pacemaker use	There is a correlation between pacemaker use and central venous stenosis.
History of severe congestive heart failure	Accesses may alter hemodynamics and cardiac output.
History of arterial or venous peripheral catheter.	Previous placement of an arterial or venous peripheral catheter may have damaged target vasculature.
History of diabetes mellitus	Diabetes mellitus is associated with damage to vasculature necessary for internal accesses.
History of anticoagulant therapy or any coagulation disorder	Abnormal coagulation may cause clotting or problems with hemostasis of accesses.
Presence of comorbid conditions, such as malignancy or coronary artery disease, that limit patient's life expectancy	Morbidity associated with placement and maintenance of certain accesses may not justify their use in some patients.
History of vascular access	Previously failed vascular accesses will limit available sites for accesses; the cause of a previous failure may influence planned access if the cause is still present.
History of heart valve disease or prosthesis	Rate of infection associated with specific access types should be considered.
History of previous arm, neck, or chest surgery/trauma	Vascular damage associated with previous surgery or trauma may limit viable access sites.

Anticipated renal transplant from living donor	Temporary access may be sufficient.
Physical Examination	
Physical Examination of Arterial System	
Character of peripheral pulses, supplemented by hand-held Doppler evaluation when indicated	An adequate arterial system is needed for access; the quality of the arterial system will influence the choice of access site.
Results of Allen test	Abnormal arterial flow pattern to the hand may contraindicate the creation of a radial-cephalic fistula.
Bilateral upper extremity blood pressures	Pressures determine suitability of arterial access in upper extremities.
Physical Examination of Venous System	
Evaluation for edema	Edema indicates venous outflow problems that may limit usefulness of the associated potential access site or extremity for access placement.
Assessment of arm size comparability	Differential arm size may indicate inadequate veins or venous obstruction which should influence choice of access site.
Examination for collateral veins	Collateral veins are indicative venous obstruction.
Tourniquet venous palpation with vein mapping	Palpation and mapping allow selection of ideal veins for access.
Examination for evidence of previous central or peripheral venous catheterization	Use of central venous catheters is associated with central venous stenosis; previous placement of venous catheters may have damaged target vasculature necessary for access.
Examination for evidence of arm, chest, or neck surgery/trauma	Vascular damage associated with previous surgery or trauma may limit access sites.
Cardiovascular Evaluation	

Examination for evidence of heart failure	Accesses may alter cardiac output.

2. Diagnostic Evaluation Prior to Permanent Access Selection
    A. Venography prior to placement of access is indicated in patients with the following:
        1. Edema in the extremity in which an access site is planned. (Evidence)
        2. Collateral vein development in any planned access site. (Evidence)
        3. Differential extremity size, if that extremity is contemplated as an access site. (Evidence)
        4. Current or previous subclavian catheter placement of any type in venous drainage of planned access. (Evidence)
        5. Current or previous transvenous pacemaker in venous drainage of planned access. (Evidence)
        6. Previous arm, neck, or chest trauma or surgery in venous drainage of planned access. (Opinion)
        7. Multiple previous accesses in an extremity planned as an access site. (Opinion)
    B. Additional or alternate imaging techniques are indicated in selected cases where multiple previous vascular accesses have been placed or when residual renal function makes contrast studies undesirable. Appropriate techniques include:
        1. Doppler ultrasound (Evidence)
        2. Magnetic resonance imaging (Opinion)
    C. Arteriography or Doppler examination is indicated when arterial pulses in the desired access location are markedly diminished. (Opinion)
3. Selection of Permanent Vascular Access and Order of Preference for Placement of Arteriovenous Fistulae
    A. The order of preference for placement of arteriovenous fistulae in patients with kidney failure who will become hemodialysis dependent is:
        1. A wrist (radial-cephalic) primary arteriovenous fistula (Evidence)
        2. An elbow (brachial-cephalic) primary arteriovenous fistula (Evidence/Opinion)
    B. If it is not possible to establish either of these types of fistula, access may be established using:
        1. An arteriovenous graft of synthetic material (for example, polytetrafluoroethylene) (Evidence) or
        2. A transposed brachial-basilic vein fistula (Evidence)
    C. Cuffed tunneled central venous catheters should be discouraged as permanent vascular access.
4. Type and Location of Dialysis Arteriovenous Graft Placement
    A. If a primary arteriovenous fistula cannot be established, a synthetic arteriovenous graft is the next preferred type of vascular access. (See Guideline 3, "Selection of Permanent Vascular Access and Order of Preferences of Placement of Arteriovenous Fistulae.") (Evidence)
    B. Polytetrafluoroethylene (PTFE) tubes are preferred over other synthetic materials. (Evidence/Opinion)

C. There is no convincing evidence to support tapered over uniform tubes, externally supported over unsupported grafts, thick-versus thin-walled configurations, or elastic versus nonelastic material. (Opinion)
D. Grafts may be placed in straight, looped, or curved configurations. Designs that provide the most surface area for cannulation are preferred. (Opinion)
E. Location of graft placement is determined by each patient's unique anatomical restrictions, the surgeon's skill, and the anticipated duration of dialysis. (Opinion)

5. Type and Location of Tunneled Cuffed Catheter Placement
   A. Tunneled cuffed venous catheters are the method of choice for temporary access of longer than 3 weeks' duration, but they are acceptable for access of shorter duration. In addition, some patients who have exhausted all other access options require permanent access via tunneled cuffed catheters. For patients who have a primary arteriovenous fistula maturing but need immediate hemodialysis, tunneled cuffed catheters are the access of choice. Catheters capable of rapid flow rates are preferred. (Evidence/Opinion)
   B. The preferred insertion site for tunneled cuffed venous dialysis catheters is the right internal jugular vein. Other options include: the right external jugular vein, the left internal and external jugular veins, subclavian veins femoral veins, or translumbar access to the inferior vena cava. Subclavian access should be used only when jugular options are not available. Tunneled cuffed catheters should not be placed on the same side as a maturing arteriovenous access, if possible. (Evidence)
   C. Fluoroscopy is mandatory for insertion of all cuffed dialysis catheters. The catheter tip must be adjusted to the level of the caval atrial junction or into the right atrium to ensure optimal blood flow. (Atrial positioning is only recommended for catheters composed of soft compliant material, such as silicone.) (Opinion)
   D. Real-time ultrasound-guided insertion is recommended to reduce insertion-related complications. (Evidence/Opinion)
   E. There is currently no proven advantage of one cuffed catheter design over another. Catheter choice should be based on local experience, goals for use, and cost. (Evidence/Opinion)
6. Acute Hemodialysis Vascular Access: Noncuffed Catheters
   A. Hemodialysis access of less than 3 weeks' duration should be obtained using a noncuffed, or a cuffed, double-lumen percutaneously inserted catheter. (For cuffed catheters, see Guideline 5, "Type and Location of Tunneled Cuffed Catheter Placement" above) (Evidence/Opinion)
   B. These catheters are suitable for immediate use and should not be inserted before needed. (Evidence)
   C. Noncuffed catheters can be inserted at the bedside in the femoral, internal jugular, or subclavian position. (Evidence)
   D. The subclavian insertion site should not be used in a patient who may need permanent vascular access. (Evidence)
   E. Chest x-ray is mandatory after subclavian and internal jugular insertion prior to catheter use to confirm catheter tip position at the caval atrial junction or the superior vena cava and to exclude complications prior to starting hemodialysis. (Evidence/Opinion)

F. Where available, ultrasound should be used to direct insertion of these catheters into the internal jugular position to minimize insertion-related complications. (Evidence/Opinion)
G. Femoral catheters should be at least 19-cm long to minimize recirculation. Noncuffed femoral catheters should not be left in place longer than 5 days and should be left in place only in bed-bound patients. (Evidence/Opinion)
H. Nonfunctional noncuffed catheters can be exchanged over a guidewire or treated with urokinase as long as the exit site and tunnel are not infected. (See the section below titled "Protocols for Urokinase Administration.") (Evidence)

Protocols for Urokinase Administration*

National Kidney Foundation-Kidney Disease Outcomes Quality Initiative Protocol for Urokinase Administration

1. Attempt to aspirate the occluded catheter lumen to remove heparin.
2. Steadily inject urokinase (1 mL or volume sufficient to fill lumen) with 3 mL or other small syringe into the occluded catheter lumen (urokinase 5,000 U/mL).
3. If needed, fill remainder of the catheter lumen with saline in the same manner (for example, for a 1.3 mL catheter lumen use 1 mL urokinase and 0.3 mL saline).
4. Add 0.3 mL saline every 10 minutes x 2 to move active urokinase to distal catheter.
5. Aspirate catheter.
6. Repeat procedure if necessary.

Manufacturer's Protocol for Urokinase Administration

7. Attempt to aspirate the occluded catheter lumen to remove heparin.
8. Steadily inject urokinase (1 mL or volume sufficient to fill lumen) with 3 mL or other small syringe into the occluded catheter lumen (urokinase 5,000 U/mL).
9. Fill entire catheter lumen (urokinase 5,000 U/mL).
10. After 30 minutes, aspirate catheter. May be repeated as needed.

*Numerous protocols for urokinase administration are in use. These are two examples.

I. Exit site, tunnel tract, or systemic infections should prompt the removal of noncuffed catheters. Treatment guidelines for catheter infection are discussed in Guideline 15, "Catheter Care and Accessing the Patient's Circulation," below (Evidence/Opinion)

7. Preservation of Veins for Arteriovenous Access
A. Arm veins suitable for placement of vascular access should be preserved, regardless of arm dominance. Arm veins, particularly the cephalic veins of the non-dominant arm, should not be used for

venipuncture or intravenous catheters. The dorsum of the hand should be used for intravenous lines in patients with chronic kidney disease. When venipuncture of the arm veins is necessary, sites should be rotated. (Opinion)

B. Instruct hospital staff, patients with progressive kidney disease (creatinine >3 mg/dL), and all patients with conditions likely to lead to end-stage renal disease, to protect the arms from venipuncture and intravenous catheters. A Medic Alert bracelet should be worn to inform hospital staff to avoid intravenous cannulation of essential veins. (Opinion)

C. Subclavian vein catheterization should be avoided for temporary access in all patients with kidney failure due to the risk of central venous stenosis. (Evidence)

8. Timing of Access Placement

A. Patients with chronic kidney disease should be referred for surgery to attempt construction of a primary arteriovenous fistula when their creatinine clearance is <25 mL/minute, their serum creatinine level is >4 mg/dL, or within 1 year of an anticipated need for dialysis. The patient should be referred to a nephrologist prior to the need for access to facilitate kidney failure treatment and for counseling about modes of end-stage renal disease care, including hemodialysis, peritoneal dialysis, and renal transplantation. (Opinion)

B. A new primary fistula should be allowed to mature for at least 1 month, and ideally for 3 to 4 months, prior to cannulation. (Opinion)

C. Dialysis arteriovenous grafts should be placed at least 3 to 6 weeks prior to an anticipated need for hemodialysis in patients who are not candidates for primary arteriovenous fistulae. (Opinion)

D. Hemodialysis catheters should not be inserted until hemodialysis is needed. (Evidence/Opinion)

9. Access Maturation

A. A primary arteriovenous fistula is mature and suitable for use when the vein's diameter is sufficient to allow successful cannulation, but not sooner than 1 month (and preferably 3 to 4 months) after construction. (Opinion)

B. The following procedures may enhance maturation of arteriovenous fistulae:

1. Fistula hand-arm exercise (for example, squeezing a rubber ball with or without a lightly applied tourniquet) will increase blood flow and speed maturation of a new native arteriovenous fistula. (Opinion)
2. Selective obliteration of major venous side branches will speed maturation of a slowly maturing arteriovenous fistula. (Opinion)
3. When a new native arteriovenous fistula is infiltrated (that is, presence of hematoma with associated induration and edema), it should be rested until swelling is resolved. (Opinion)

C. Polytetrafluoroethylene dialysis arteriovenous grafts should not routinely be used until 14 days after placement. Cannulation of a new polytetrafluoroethylene dialysis arteriovenous graft should not routinely be attempted, even 14 days or longer after placement, until swelling has gone down enough to allow palpation of the course of the graft. Ideally, 3 to 6 weeks should be allowed prior to cannulation of a new graft. (Opinion)

D. Patients with swelling that does not respond to arm elevation or that persists beyond 2 weeks after dialysis arteriovenous access placement should receive a venogram or other non-contrast study to evaluate central veins. (Opinion)
E. Cuffed and noncuffed hemodialysis catheters are suitable for immediate use and do not require maturation time. (Evidence)

10. Monitoring, Surveillance, and Diagnostic Testing

Monitoring Dialysis Arteriovenous Grafts for Stenosis

Physical examination of an access graft should be performed weekly and should include, but not be limited to, inspection and palpation for pulse and thrill at the arterial, mid, and venous sections of the graft. (Opinion)

The Work Group recommends an organized monitoring approach with regular assessment of clinical parameters of the arteriovenous access and dialysis adequacy. Data from the clinical assessment and dialysis adequacy measurements should be collected and maintained for each patient's access and made available to all staff. The data should be tabulated and tracked within each dialysis center as part of a Quality Assurance/Continuous Quality Improvement (QA/CQI) program. (Opinion)

Surveillance of Arteriovenous Grafts

Prospective surveillance of arteriovenous grafts for hemodynamically significant stenosis, when combined with correction, improves patency and decreases the incidence of thrombosis. (Evidence) Techniques, not mutually exclusive, that can be used in surveillance for stenosis in arteriovenous grafts include, in order of decreasing preference:

Preferred

1. Intra-access flow (protocol provided below) (Evidence)

<u>Access Flow Surveillance Protocol</u>

- Access flow measured by ultrasound dilution, conductance dilution, thermal dilution, Doppler or other technique should be performed monthly. The assessment of flow should be performed monthly. The assessment of flow should be performed during the first 1.5 hours of the treatment to eliminate error caused by decreases in cardiac output related to ultrafiltration. The mean value of 3 separate determinations performed at a single treatment should be considered the access flow.
- Arteriovenous graft and arteriovenous fistula
- Access flow less than 600 mL/min, the patient should be referred for fistulogram.
- Access flow less than 1,000 mL/min that has decreased by more than 25% over 4 months should be referred for fistulogram.

2. Static venous dialysis pressure (protocol provided below) (Evidence)

Static Intra-Access Pressure (IAP) Surveillance Protocol

0. Establish a baseline when the access has matured and shortly after the access is first used. Trend analysis is more useful than any single measurement.
1. Assure that the zero setting on the pressure transducers of the dialysis delivery system being used has been calibrated to be accurate within plus or minus 5 mm Hg. If uncertain check the calibration (Step 8).
2. Measure the mean arterial blood pressure in the arm contralateral to the access.
3. Enter the appropriate output or display screen where venous and arterial pressures can be visualized (this varies for each dialysis delivery system). If a gauge is used to display pressures, the pressure can be read from the gauge.
4. Stop the blood pump and cross clamp the venous line just proximal to the venous drip chamber with a hemostat (this avoids having to stop ultrafiltration for the brief period needed for the measurement). On the arterial line, no hemostat is needed since the occlusive roller pump serves as a clamp.
5. Wait 30 seconds until the venous pressure is stable, then record the arterial and venous intra-access pressure (IAP) values. The arterial segment pressure can only be obtained if a pre-pump drip chamber is available and the dialysis system is capable of measuring absolute pressures greater than 40 mm Hg.
6. Unclamp the venous return line and restore the blood pump to its previous value.
7. If uncertain about the accuracy of the zero value on the pressure transducers, clamp the tubing from the drip chamber(s) to the pressure transducer protector(s). Pull off the pressure protector(s) from their nipples and record the zero value(s), P_o (these are usually close to zero, but may deviate by 10 mm Hg or more below or above zero). Replace the pressure transducer(s) protector(s) and unclamp the line(s).
8. Determine the offset pressure(s), P_{offset} between the access and the drip chamber(s) either by direct measurement (A) or using a formula (B) based on the difference in height between the top of the drip chamber and the top of the arm rest of the dialysis chair.
    A. Measure the height from the venous or arterial needle to the top of the blood in the venous drip chamber in cm. The offset in Hg = height (cm) x 0.76. For practical purposes the same value can be used for both if the drip chambers are at the same height.
    B. Use the formula, offset in mm Hg = 3.6 + 0.35 x the difference in height between the top of the drip chamber and the top of the arm rest of the dialysis chair. The same value can be used for both if the drip chambers

are the same height. If the drip chambers are not at equal heights, the arterial and venous height offsets must be determined individually. In a given patient with a given access the height offsets need to be measured only once and then used until the access location is altered by construction of a new access.

9. Calculate the normalized arterial and venous segment static intra-access pressure ratio(s), P_{IA}.

   Arterial P_{IA} = (arterial IAP + arterial P_{offset} - arterial P_o) /mean arterial blood pressure

   Venous P_{IA} = (venous IAP + venous P_{offset} - venous P_o)/mean arterial blood pressure

Note: If the P is less than zero, algebraically subtracting a negative number is equivalent to adding the absolute number. Interpretation: Venous outlet stenosis can be detected with the venous P_{IA} alone. Trend analysis is more useful than any single measurement. The higher degree of stenosis at the outlet, the greater is the venous (P_{IA}) pressure ratio. Strictures between the area of arterial and needle cannulation cannot be detected by measuring venous (P_{IA}) pressure alone. Detection of these lesions requires the simultaneous measurement of pressures from both the arterial and venous needles. Central stenosis that have collateral circulation may have "normal pressures," but these usually present with significant ipsilateral edema. Accesses can be classified into the categories listed in the table below using the equivalent P_{1A} ratios from the arterial or venous needles; the criteria must be met on each of two consecutive weeks to have a high likelihood of a 50% diameter lesion. The criterion in bold type is the primary criterion for the location of the stenosis, the other is supportive.

Access Type	Graft	Graft	Native	Native
Normalized P_{IA}	Arterial Ratio	Venous Ratio	Arterial Ratio	Venou
Normal	0.35 to 0.74	0.15 to 0.49	0.13 to 0.43	0.08 t
Stenosis				
Venous outlet	$\geq$0.75	$\geq$0.5	>0.43 or	$\geq$0.3
Intra-access	$\geq$0.75 and	<0.5	>0.43 and	$\leq$0.3

Arterial inflow	<0.3	NA	<0.13 + clinical findings	NA

Patients who develop a progressive and reproducible increase in venous or arterial segment greater than 0.25 above their previous baseline irrespective of access type are also likely to have a hemodynamically significant lesion. Intra-access strictures are usually characterized by the development of a difference between the arterial and venous pressure ratios >0.5 in grafts or >0.3 in native fistula.

Acceptable

C. Dynamic venous pressures (protocol provided below) (Evidence)

Dynamic Venous Dialysis Pressure Surveillance Protocol

- Establish a baseline by initiating measurements when the access is first used.
- Measure venous dialysis pressure from the hemodialysis machine at Qb 200 mL/minute during the first 2 to 5 minutes of hemodialysis at every hemodialysis session.
- Use 15-gauge needles (or establish own protocol for different needle size).
- Assure that the venous needle is in the lumen of the vessel and not partially occluded by the vessel wall.
- Pressure must exceed the threshold three times in succession to be significant.
- Assess at same level relative to hemodialysis machine for all measurements.

Interpretation of Results

Three measurements in succession above the threshold are required to eliminate the effect of variation caused by needle placement. Hemodialysis machines measure pressure with different monitors and tubing types and lengths. These variables, as well as needle size, influence venous dialysis pressure. The most important variable affecting the dynamic pressure at a blood flow of 200 mL/minute is the needle gauge. It is essential to set thresholds for action based on machine manufacturer, tubing type, and needle gauge.

Using 15-gauge needles, the threshold that indicates elevated pressure (and therefore the likely presence of a hemodynamically significant venous outlet stenosis) for Cobe Centry 3 machines is a pressure of 125 mm Hg, whereas the threshold for Gambro AK 10 machines is a pressure of 150 mm Hg. Data for Baxter, Fresenius, Althin, and other dialysis machines are not available but are likely to be similar to those of the Cobe Centry 3 if the same gauge venous

needle is used. Trial and error at each institution will determine each units' threshold pressure.

Trend analysis is more important than any single measurement. Upward trends in hemodialysis pressure over time are more predictive than absolute values. Each unit should establish its own venous pressure threshold values.

Patients with progressively increasing pressures or those who exceed the threshold on three consecutive hemodialysis treatments should be referred for venography.

Other studies or information that can be useful in detecting arteriovenous graft stenosis include:

4. Measurement of access recirculation using urea concentrations. (see Guideline 12, "Recirculation Methodology, Limits, Evaluation, and Follow-up," below) (Evidence)
5. Measurement of recirculation using dilution techniques (nonurea-based) (Evidence)
6. Unexplained decreases in the measured amount of hemodialysis delivered (urea reduction ratio, Kt/V) (Evidence)
7. Physical findings of persistent swelling of the arm, clotting of the graft, prolonged bleeding after needle withdrawal, or altered characteristics of pulse or thrill in a graft. (Evidence/Opinion)
8. Elevated negative arterial pre-pump pressures that prevent increasing to acceptable blood flow. (Evidence/Opinion)
9. Doppler ultrasound (Evidence/Opinion)

Diagnostic Testing in Arteriovenous Grafts

Persistent abnormalities in any of these parameters should prompt referral for venography. (Evidence)

2. Monitoring Primary Arteriovenous Fistulae for Stenosis

Primary arteriovenous fistulae should be monitored as outlined for dialysis arteriovenous grafts. (See Guideline 10, "Monitoring Dialysis Arteriovenous Grafts for Stenosis," above) (Opinion)

Direct flow measurements, if available, are preferable compared to more indirect measures. (Evidence)

Methods appropriate for monitoring stenosis in grafts (for example, static and dynamic venous pressures) are not as accurate for monitoring in primary arteriovenous fistulae. (Evidence) Recirculation and Doppler analysis are of potential benefit. (Opinion)

3. Recirculation Methodology, Limits, Evaluation, and Follow-up

D. Recirculation should be measured using a nonurea-based dilutional method or by using the two-needle urea-based method. The three-needle peripheral vein method of measuring recirculation should not be used. (Evidence)
E. Any access recirculation is abnormal. Recirculation exceeding 10% using the recommended two-needle urea-based method, or 5% using a nonurea-based dilutional method, should prompt investigation of its cause. (Evidence)
F. If access recirculation values exceed 20%, correct placement of needles should be confirmed before conducting further studies. (Evidence/Opinion)
G. Elevated levels of access recirculation should be investigated using angiography (fistulography) to determine whether stenotic lesions are impairing access blood flow. (Evidence)

2. Infection Control Measures

Staff and patient education should include instruction on infection control measures for all hemodialysis access sites. (Opinion)

3. Skin Preparation Technique for Permanent Arteriovenous Accesses

A clean technique for needle cannulation should be used for all cannulation procedures.(Evidence)

Proposed Skin Preparation Technique

4. Locate and palpate the needle cannulation sites prior to skin preparation.
5. Wash access site using an antibacterial soap or scrub (for example, 2% chlorhexidine) and water.
6. Cleanse the skin by applying 70% alcohol and/or 10% povidone iodine using a circular rubbing motion.

Notes:

- Alcohol has a short bacteriostatic action time and should be applied in a rubbing motion for 1 minute immediately prior to needle cannulation.
- Povidone iodine needs to be applied for 2 to 3 minutes for its full bacteriostatic action to take effect and must be allowed to dry prior to needle cannulation.
- Clean gloves should be worn by the dialysis staff for cannulation procedure. Gloves should be changed if contaminated at any time during the cannulation procedure.
- New, clean gloves should be worn by the dialysis staff for each patient.

There is no literature to support the use of specific technique for cannulation. The Work Group recommends the technique described below in Table III-9:

Table III-9. Technique for Arteriovenous Fistula/Arteriovenous Graft Cannulation

Technique	Rationale
After skin preparation, pull skin taut in opposite direction of needle insertion	o Compresses peripheral endings between epidermis an dermis o Facilitates smoother inc skin with less surface area con cutting edge of needle o Enables better stabiliza graft or vessel to be cannulate
Use approximately 45 degree angle of insertion for arteriovenous graft and approximately 25 degree angle for arteriovenous fistula	Less steep angles increase risk of dragging cutting edge of needle alc surface of vessel. Steeper angles ir risk of perforating underside of ves
Once the vessel has been penetrated, there are basically three methods employed in extant practice:	
0. Advance the needle slowly with cutting edge facing top of vessel and do not rotate axis	1. Any manipulation may traumatize the intima of the ve
2. Immediately rotate the axis of the needle 180 degrees and advance slowly with cutting edge facing bottom of the vessel	2. Rotating the axis avoids traumatizing the top of intima
3. Advance the needle to desired position then rotate the axis 180 degrees	3. Waiting to rotate axis a traumatizing top of vessel whil needle is taped in place
Tape the needle at the same angle or one similar to the angle of insertion	Pressing the needle shaft flat agair skin moves the needle tip from the desired position within the vessel l
Remove needle at same or similar angle to the angle of insertion, and NEVER APPLY PRESSURE BEFORE THE NEEDLE IS COMPLETELY OUT	Avoid trauma to any intima by drag cutting edge along it. Avoid pressir cutting edge into intima when appl pressure for hemodialysis.

2. Catheter Care and Accessing the Patient's Circulation

Catheter care and accessing the patient's circulation should be clean procedures.

. Hemodialysis catheter dressing changes and catheter manipulations that access the patient's bloodstream should only be performed by trained dialysis staff. (Evidence/Opinion)

A. The catheter exit site should be examined at each hemodialysis treatment for signs of infection. (Opinion)
B. Catheter exit site dressings should be changed at each hemodialysis treatment. (Opinion)
C. Use of dry gauze dressings combined with skin disinfection, using either chlorhexidine or povidone iodine solution, followed by povidone iodine ointment or mupirocin ointment at the catheter exit site are recommended after catheter placement and at the end of each dialysis session. (Evidence)
D. Manipulating a catheter and accessing the patient's bloodstream should be performed in a manner that minimizes contamination. (Evidence)

Considerations for Accessing the Bloodstream Using Catheters

- The catheter hub caps or bloodline connectors should be soaked for 3 to 5 minutes in povidone iodine and then allowed to dry prior to separation.
- Catheter lumens should be kept sterile.
- To prevent contamination, the lumen and tip should never remain open to the air. A cap or syringe should be placed on or within the catheter lumen, while maintaining a clean field under the catheter connectors.
- Patients should wear surgical mask for all catheter procedures that remove the catheter caps and access the patient's bloodstream.
- Dialysis staff should wear gloves and a surgical mask or face shield for all procedures that remove catheter caps and access the patient's bloodstream.
- A surgical mask for the patient and mask or face shield for the dialysis staff should be worn for all catheter dressing changes.

E. During catheter connect and disconnect procedures, nurses and patients should wear a surgical mask or face shield. Nurses should wear gloves during all connect and disconnect procedures. (Opinion)

2. Managing Potential Ischemia in a Limb Bearing an Arteriovenous Access

. All patients, particularly those in high-risk groups, should be monitored for the development of limb ischemia following arteriovenous access construction.

0. Patients in high-risk groups (diabetic, elderly, those with multiple access attempts in an extremity) should be monitored closely for the first 24 hours post-operatively. Monitoring should include: (Opinion)

a. Subjective assessment of complaints, including sensations of coldness, numbness, tingling, and impairment of motor function (not limited by post-operative pain)
b. Objective assessment of skin temperature, gross sensation, and movement and distal arterial pulses in comparison to the contralateral side
c. Teaching patients to immediately report any coldness, loss of motion, or significant reduction in sensation.

1. Patients with an established fistula should be assessed monthly. The following are recommended as part of this assessment: (Opinion)
   a. Obtaining an interval history of increased distal coldness or distal pain during dialysis, decreased sensation, weakness or other reduction in function, or skin changes
   b. Confirming any abnormalities by physical examination
2. Patients with new findings suggestive of ischemia should be referred to a vascular access surgeon emergently. Reduced skin temperature, as an isolated finding, requires follow-up observation but no emergent intervention. (Opinion)

3. When to Intervene: Dialysis Arteriovenous Grafts for Venous Stenosis, Infection, Graft Degeneration, and Pseudoaneurysm Formation

Appropriate intervention in arteriovenous grafts should be initiated upon identification of:

. Hemodynamically significant stenosis. (See Guideline 10, "Monitoring Dialysis Grafts for Stenosis," above) (Evidence)

A. Infection-an infected graft should be treated surgically. (Evidence)
B. Graft degeneration and pseudoaneurysm formation-grafts should be surgically revised when:
   0. Severe degenerative changes of the graft or overlying skin are present. (Opinion)

1. Skin above the graft is compromised. (Opinion)
2. There is a risk of graft rupture due to poor eschar formation or there is evidence of spontaneous bleeding. (Opinion)
3. Limited puncture sites are available due to the presence of a large (or multiple) pseudoaneurysm(s). (See Guideline 27, "Treatment of Pseudoaneurysm of Dialysis Arteriovenous Grafts," below) (Opinion)

4. When to Intervene: Primary Arteriovenous Fistulae

Appropriate intervention in primary arteriovenous fistulae should be initiated upon identification of:

. Inadequate flow to support the prescribed dialysis blood flow. (Evidence/Opinion)

A. Hemodynamically significant venous stenosis. (Evidence)
B. Aneurysm formation-a primary arteriovenous fistula should be revised when an aneurysm develops if: (Opinion)
   0. The skin overlying the fistula is compromised.

1. There is a risk of fistula rupture.
2. Available puncture sites are limited.

5. Treatment of Stenosis Without Thrombosis in Dialysis Arteriovenous Grafts and Primary Arteriovenous Fistulae

Stenosis Treatment:

. Stenoses that occur in a dialysis arteriovenous graft or primary arteriovenous fistula (venous outflow or arterial inflow) should be treated with percutaneous transluminal angioplasty or surgical revision if the stenosis is >50% of the lumen diameter and is associated with the following clinical/physiologic abnormalities: (Evidence)

0. Previous thrombosis in the access
1. Elevated venous dialysis pressure
2. Abnormal urea or other recirculation measurements
3. Abnormal physical findings
4. Unexplained decrease in measurement of dialysis dose
5. Decreasing access flow (See Guideline 17, "When to Intervene: Dialysis Arteriovenous Grafts for Venous Stenosis, Infection, Graft Degeneration and Pseudoaneurysm Formation," above, and Guideline 18, "When to Intervene: Primary Arteriovenous Fistulae," above)

A. Each dialysis center should determine which procedure (angioplasty versus surgical revision) is best for the patient based on the expertise at that center. (Evidence/Opinion)
B. Stenosis, as well as the clinical parameters used to detect it, should return to within acceptable limits following intervention. (Evidence)

Stenosis Treatment Outcomes:

C. Centers should monitor stenosis treatment outcomes on the basis of patency; reasonable patency goals (for the center as a whole) for percutaneous transluminal angioplasty (PTA) and surgical revision in the absence of thrombosis are:

PTA: 50% unassisted patency* at 6 months (Evidence) no more than 30% residual stenosis post-procedure and resolution of physical indicator(s) of stenosis

Surgical Revision: 50% unassisted patency at 1 year (Opinion)

* Unassisted patency is defined as either a thrombosis or access failure or an intervention to prevent thrombosis is performed.

D. If angioplasty is required more than 2 times within 3 months, the patient should be referred for surgical revision if such an option is available and if the patient is a good surgical candidate. (Opinion)
E. Stents are useful in selected instances (for example, limited residual access sites, surgically inaccessible lesions, contraindication to surgery) when percutaneous transluminal angioplasty fails. (Evidence)

6. Treatment of Central Vein Stenosis

Percutaneous intervention with transluminal angioplasty is the preferred treatment for central vein stenosis. (Evidence)

Stent placement combined with angioplasty is indicated in elastic central vein stenoses or if a stenosis recurs within a 3-month period. (Evidence)

7. Treatment of Thrombosis and Associated Stenosis in Dialysis Arteriovenous Grafts

Thrombosis Treatment

Thrombosis of an arteriovenous graft should be corrected with surgical thrombectomy or with pharmacomechanical or mechanical thrombolysis. The choice of technique to treat thrombosis should be based on the expertise of the center. However, it is essential that:

. Treatment be performed rapidly following detection of thrombosis to minimize the need for temporary access. (No more than one, and preferably, no femoral vein catheterization should be required.) (Opinion)

A. The access be evaluated by fistulogram for residual stenosis post-procedure. (Evidence)
B. Residual stenosis be corrected by angioplasty or surgical correction. (Note: Outflow venous stenoses are present in greater than 85% of instances of thrombosis; the need for percutaneous transluminal angioplasty or surgical revision is expected in most instances.) (Evidence)
C. The procedure be performed as outpatient procedure under local anesthesia. (Access revision may require up to a 24-hour observation to evaluate swelling and steal.) (Opinion)
D. Monitoring tests used to screen for venous obstruction should return to normal following intervention. (See Guidelines 10, 17, and 18). (Evidence)

Patency goals following thrombosis. Centers should monitor outcome results on the basis of patency; minimum reasonable goals (for the center as a whole) for percutaneous thrombolysis and surgical revision thrombectomy should be:

- Percutaneous thrombolysis with percutaneous transluminal angioplasty: 40% unassisted patency and functionality at 3 months (Evidence)
- Surgical thrombectomy and revision: 50% unassisted patency and functionality at 6 months and 40% unassisted patency and functionality at 1 year (Opinion)
- For both techniques: Immediate patency, defined as patency to the next dialysis session, of 85%.

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

Evidentiary Basis for Guidelines

The National Kidney Foundation-Kidney Disease Outcomes Quality Initiative guidelines were developed using an evidence-based approach similar to the one used by the Agency for Healthcare Research and Quality (AHRQ) (formerly the Agency for Health Care Policy and Research [AHCPR]). That is, before formulating recommendations, the Work Groups reviewed all published evidence pertinent to the topics being considered, and critically appraised the quality and strength of that evidence. For many issues that the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative Work Groups chose to address, there either was no pertinent literature available, or available evidence was flawed or weak. As a result, in many instances the Work Groups formulated their recommendations based on the opinions of the Work Group members and comments received from the peer reviewers. In all instances, the Work Groups have documented the rationale for their recommendations. That is, they have articulated each link in the chain of logic they used as the evidentiary or opinion-related basis for their recommendation. This approach will help readers of the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative guidelines determine the quantity and quality of evidence underlying each recommendation.

Although some of the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative guidelines are clearly based entirely on evidence or entirely on opinion, many are based in part on evidence and in part on opinion. Such "hybrid" guidelines arise when some (or even most) of the links in the chain of logic underlying a guideline are based on empirical evidence, but some (that is, at least one) are based on opinion. The opinion of the Work Group members can enter the chain of logic that supports a guideline either to fill in a gap in available evidence on some scientific or clinical issue, or in the form of a value judgment regarding what they feel is appropriate clinical practice based on available evidence. Thus, many opinion-based guidelines may have substantial empirical evidence underlying them.

To help readers determine the basis for each guideline, the Work Groups have provided their rationale for each guideline. When all components of the rationale for a guideline are based on published evidence, the guideline has been labeled "Evidence." When some or all components of a rationale are based on opinion, the guideline has been labeled "Opinion."

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

- Enhanced long-term access function
- Reduction of costs associated with the maintenance of access patency
- Early identification of patients with progressive renal failure and the identification and protection of potential native fistula construction sites, particularly sites using the cephalic vein

- Detection of access dysfunction prior to access thrombosis or other complication

POTENTIAL HARMS

Complications of vascular access placement and maintenance (for example, infection, stenosis, thrombosis, aneurysm, and limb ischemia).

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

From the 1997 Guideline

1. These guidelines are based upon the best information available at the time of publication. They are designed to provide information and assist decision making. They are not intended to define a standard of care, and should not be construed as one. Neither should they be interpreted as prescribing an exclusive course of management. Variations in practice will inevitably and appropriately occur when clinicians take into account the needs of individual patients, available resources, and limitations unique to an institution or type of practice. Every health-care professional making use of these guidelines is responsible for evaluating the appropriateness of applying them in the setting of any particular clinical situation.
2. The Work Group was unable to reach a consensus on a preferred location for arteriovenous grafts. The two preferred graft site types are the antecubital loop graft and the upper arm curved graft.
3. Although there are no definitive data in the literature, any intervention that increases blood flow to the extremity may improve the chances of successful fistula development. Therefore, regular hand-arm exercises, with or without a lightly applied tourniquet, are recommended until the fistula matures.
4. Failure of a fistula to mature is occasionally due to venous side branches that drain critical flow from the primary vessel. Ligating these side branches may result in successful maturation: however, the Work Group was not unanimous on this topic.
5. Since pressure measurement and recirculation may be late predictors of access dysfunction in arteriovenous fistulae, Doppler ultrasound may be useful despite its increased cost. However, the absence of validation studies precludes Work Group recommendations at this time.
6. Prospective studies correcting 50% stenosis not associated with a hemodynamic, functional, or clinical abnormality have not been performed. Until these studies are performed, there is no convincing evidence that correction of asymptomatic 50% stenosis will decrease thrombosis.
7. Available data do not indicate a clear-cut preference between surgical thrombectomy and revision and percutaneous mechanical or pharmacomechanical thrombolysis. Comparative studies show conflicting results, with similar technical success rates and long-term patencies between these methodologies. Non-comparative studies do not yield a definitive preference. In the Work Group's opinion, current data suggest surgical thrombectomy and mechanical and pharmacomechanical thrombolysis are all effective for resolving thrombosis.

8. Little data on the success of treating thrombosis in native arteriovenous fistulae are reported. The Work Group believes that treatment of thrombosis in native arteriovenous fistulae is not as successful as treatment of thrombosis in arteriovenous grafts.

The Work Group's recommendations on infection rates are significantly lower than the published experiences of various centers. The Work Group believes infection rates can be significantly lowered through meticulous attention to detail, and in the case of catheters, following the previous guideline recommendations on skin preparation at the time of placement, topical antibiotics, and the use of non-occlusive dressings.

From the 2000 Update

1. While extensive effort has gone into the guideline development process, and careful attention has been paid to detail and scientific rigor, it is absolutely essential to emphasize that these documents are guidelines, not standards or mandates. Each recommendation in the guidelines is accompanied by a rationale, enabling caregivers of patients with chronic kidney disease to make informed decisions about the proper care plan for each individual patients. Variations in practice are expected and can be appropriate.
2. Urokinase is currently not available on the United States market. Preliminary studies using thromboplastin activator and recombinant urokinase in the treatment of hemodialysis catheter dysfunction are underway and appear promising. At this time neither agent has sufficient evidence for the guidelines to recommend their wholesale adoption.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

National Kidney Foundation-Kidney Disease Outcomes Quality Initiative Implementation Planning

Based on broad-based input and careful thought, the National Kidney Foundation-Kidney Disease Outcomes Quality Initiative leadership has decided to undertake three types of activities to promote implementation of its recommendations.

- Translating recommendations into practice. National Kidney Foundation-Kidney Disease Outcomes Quality Initiative will develop core patient and professional education programs and tools to facilitate the adoption of their recommendations.
- Building commitment to reducing practice variations. National Kidney Foundation-Kidney Disease Outcomes Quality Initiative will work with providers and insurers to clarify the need for and the benefits of changes in practice patterns and to encourage the adoption of the guidelines.
- Evaluation. National Kidney Foundation-Kidney Disease Outcomes Quality Initiative will develop performance measures that can be used to assess compliance with the Disease Outcomes Quality Initiative practice guidelines. In addition, the association between compliance with the Disease Outcomes

Quality Initiative guidelines and patient outcomes will be evaluated in an effort to validate and improve the guidelines over time.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Living with Illness

IOM DOMAIN

Effectiveness
Patient-centeredness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

NKF-K/DOQI clinical practice guidelines for vascular access: update 2000. Am J Kidney Dis 2001 Jan;37(1 Suppl 1):S137-81. [209 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1997 (updated 2000)

GUIDELINE DEVELOPER(S)

National Kidney Foundation - Disease Specific Society

SOURCE(S) OF FUNDING

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GUIDELINE COMMITTEE

NKF-K/DOQI (National Kidney Foundation-Kidney Disease Outcomes Quality Initiative) Vascular Access Work Group

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Vascular Access Work Group Members: Steve Schwab, MD, Work Group Chair; Anatole Besarab, MD, Work Group Vice-Chair; Gerald Beathard, MD, PhD; Deborah Brouwer, RN, CNN; Edward Etheredge, MD; Marguerite Hartigan, MSN, RN, CNN; Michael Levine, MD; Richard McCann, MD; Richard Sherman, MD; Scott Trerotola, MD

K/DOQI Co-Chairs: Garabed Eknoyan, MD; Nathan W. Levin, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

All Work Group members completed a disclosure statement certifying that any potential conflict of interest would not influence their judgment or actions concerning the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NKF-K/DOQI).

Steve Schwab, MD, reported receiving grant funding from the National Institutes for Health (NIH) and Amgen Inc. He serves on medical advisory boards for Gambro, VascA Inc., and Amgen Inc.

Anatole Besarab, MD, FACP reported affiliations with Amgen Inc. and Schein Pharmaceuticals.

Richard Sherman, MD, is a member of the speakers program for Amgen, Inc. and Ortho Biotech, Inc. and serves as a consultant to Aksys, Ltd. Dr. Sherman reported receiving grant funding from Baxter Healthcare and R & D Laboratories.

GUIDELINE STATUS

This is the current release of the guideline. It updates a previously issued version of the guideline (Clinical practice guidelines for vascular access. New York [NY]: National Kidney Foundation; 1997. 156 p. [Dialysis outcomes quality initiative (DOQI)]).

GUIDELINE AVAILABILITY

Electronic copies: Available from the National Kidney Foundation (NKF) Web site.

Print copies: Available from NKF, 30 East 33rd St., New York, NY 10016. These guidelines are also available on CD-ROM from NKF.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- Schwab S. Vascular access. Executive summary. 2001. Available from the National Kidney Foundation (NKF) Web site.
- Steinberg EP, Eknoyan G, Levin NW, Eschbach JW, Golper TA, Owen WF, Schwab S. Methods used to evaluate the quality of evidence underlying the National Kidney Foundation-Dialysis Outcomes Quality Initiative clinical practice guidelines: description, findings and implications. Am J Kidney Dis 2000 Jul;36(1):1-11.

- Eknoyan G, Levin NW, Eschbach JW, Golper TA, Owen WF Jr, Schwab S, Steinberg EP. Continuous quality improvement: DOQI becomes K/DOQI and is updated. National Kidney Foundation's Dialysis Outcomes Quality Initiative. Am J Kidney Dis 2001 Jan;37(1):179-94. Available from the NKF Web site.

Print copies: Available from NKF, 30 East 33rd St., New York, NY 10016.

PATIENT RESOURCES

The following patient information is available.

- Getting the most from your treatment. What you need to know about your access. New York (NY): National Kidney Foundation (NKF), 1998.

Print copies: Available from NKF, 30 East 33rd St., New York, NY 10016.

Please note: This patient information is intended to provide health professionals with information to share with their patients to help them better understand their health and their diagnosed disorders. By providing access to this patient information, it is not the intention of NGC to provide specific medical advice for particular patients. Rather we urge patients and their representatives to review this material and then to consult with a licensed health professional for evaluation of treatment options suitable for them as well as for diagnosis and answers to their personal medical questions. This patient information has been derived and prepared from a guideline for health care professionals included on NGC by the authors or publishers of that original guideline. The patient information is not reviewed by NGC to establish whether or not it accurately reflects the original guideline's content.

NGC STATUS

This summary was completed by ECRI on September 1, 2001. The information was verified by the guideline developer as of November 19, 2001.

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